State of California
The Resources Agency
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Wildlife Management Division

CALIFORNIA LEAST TERN FIELD STUDY
1989 BREEDING SEASON

by

Barbara W. Massey
1825 Knoxville Ave.
Long Beach, CA 90815

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NONGAME BIRD AND MAMMAL SECTION REPORT

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CONTRACTOR

California State University, Long Beach Foundation
Long Beach, CA 90840

PRINCIPAL INVESTIGATOR

Barbara W. Massey
1825 Knoxville Ave.
Long Beach, CA 90815

PROJECT ADMINISTRATOR

Dr. Charles T. Collins
Department of Biology
California State University
Long Beach, CA 90840

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DECEMBER 1989

ABSTRACT

In 1989, 1240 pairs of California Least Terns (*Sterna antillarum browni*) bred at 28 sites in the state, about the same number as in 1988 (1253 pairs). The number of breeding sites was the same, but several were new this year, and several used in 1988 were not in use in 1989. Productivity was way down, with an estimated 764 fledglings (fledgling/pair ratio = 0.59), as compared to 1130 in 1988 (f/p ratio = 0.9). Mean clutch size was reduced (1.93±0.49 in 1988; 1.84±0.48 in 1989), an indicator of problems with the food supply. Nesting by younger adults (age 2 & 3 yrs) was behind schedule and much reduced, factors also linked to food supply.

The major cause of egg and chick loss was predation, with American Kestrel, Northern Harrier, American Crow, Striped Skunk, and ground squirrel causing the most serious losses. Despite major predator control programs at several colonies in San Diego County, fledgling production was low. Human disturbance continued to harm the colony at Tijuana Slough.

A study conducted at Venice resulted in a technique for doing standardized fledgling counts on a statewide basis.

Wildlife Management Division, Nongame Bird and Mammal Section Report

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[2] Current address: 1825 Knoxville Ave., Long Beach, CA 90815.

INTRODUCTION

A census of the state's breeding population of California Least Terns has been done annually since 1973. It is conducted by monitors who check the colonies on a weekly basis (or more frequently), and make mid-season and final reports. These include date of first nest, chick, and fledgling; number of pairs in first and second nesting waves; clutch size (where obtainable); number of visits; duration of the period of breeding activity at a colony; estimated number of fledglings; problems such as predators and steps taken to alleviate them. At selected sites, research is being conducted on various aspects of Least Tern breeding biology; banding of chicks and color banding of adults are the major research methods.

A study was conducted at Venice to devise a standardized technique for doing fledgling counts (Massey 1990). It is reported separately.

The colony reports which follow are summaries of the monitors' reports.

COLONY REPORTS

P.G. & E. PLANT, PITTSBURG (L. Collins)
Breeding pairs: 3-4

Four nests representing 3-4 pairs of terns produced two fledglings. No particular predator is a suspect.The site was monitored on 15 visits between 15 Apr and 25 July.

ALLIED CHEMICAL CO., PORT CHICAGO (L. Collins)
Breeding pairs: 0

No terns were in evidence on 15 visits between 24 Apr and 25 July.

NAVAL AIR STATION, ALAMEDA (L. Collins)
Breeding pairs: 72-75

This colony experienced another good season, with 83-93 fledglings produced from 78 nests representing 72-75 pairs. There were 67 nests in the 1st nesting wave, 11 in the 2nd. A very successful hatching and fledging rate in the 1st wave meant very little renesting; most 2nd wave pairs were considered new nesters. Fledging success was 1.15 - 1.24 fledglings/pair.

The site was monitored intensively, with 88 visits between 5 Apr and 1 Aug. In April Roundup was used for vegetation control and oyster shells were scattered on the substrate. Cat trapping was begun late; 21 cats and one skunk were removed.

Three strands of wire were added to the electric fence around the site, improving its effectiveness. Mammalian predators were not a problem.

There was no apparent predation in the colony until early July, when Northern Harriers began to frequent the area. The majority of the young had fledged, but harriers took at least 15 chicks, two fledglings and probably one clutch of 2 eggs. On 11 July, The US Dept. of Agriculture's Animal Damage Control (ADC) was called in and 3 harriers were shot, two females and a juvenile. One female survived and was taken to Lindsey Museum for rehabilitation, with the intention of relocating her after recovery. However, she broke her leg in the aviary and was euthanized. Five harriers were still in evidence after 11 July (two adults, 3 juveniles), but there was no further predation.

This was the 5th consecutive year of successful reproduction at this colony, which benefits from intensive monitoring to identify problems, and immediate steps taken to eliminate them.

OAKLAND AIRPORT (L.R. Feeney)
Breeding pairs: 6-9

Only two fledglings were produced from 9 nests, with predation on chicks the main problem. There were 7 nests in the 1st wave, 2 in the 2nd wave.

A major effort at vegetation control was done in April by the East Bay Conservation Corps. Dense clumps of pampas grass were bulldozed from areas adjacent to the colony, greatly improving the site.

The colony was monitored on 48 visits between 12 May and 23 Aug. In early June, before the first tern nest hatched, 5 young Northern Harriers were chased down and caught at the airport. They were taken to Lindsey Museum and eventually relocated at Grizzley Island Wildlife Area. Six others fledged successfully. One clutch of tern eggs was probably taken by a harrier, and very likely some chicks. A Burrowing Owl was in residence close to the site, and the owl was implicated as a predator on chicks. Efforts to catch it were unsuccessful, and the monitor resorted to supplying it with dead mice at the mouth of the burrow to deter it from taking tern chicks.

No mammals were implicated as predators, but traps around the periphery caught one cat, one opossum and one gray fox.

BAUMBERG SALT PONDS (L. Collins, L. Feeney)
Breeding pairs: 0

The salt ponds were again used by juveniles and their parents for feeding and roosting after the breeding season. There were more terns this year; the maximum number seen on one visit was 142 at 4 ponds on 19 July, as compared to the

high count of 58 at 4 ponds on 10 Aug 1988. There were also twice as many juveniles on these same dates; 52 compared with 22 in 1988. The increased number of pairs this year at Alameda, plus continued high breeding success were factors in the increased use of the area.

Eight weekly visits were made starting 12 July and ending 9 Aug. There were already terns present on the 1st visit; none were seen on the last one.

BAIR ISLAND (P. Woodin, San Francisco Bay Bird Observatory staff and members, San Jose State Univ Wildlife Management class)
Breeding pairs: 0

In the early 1980's the colony numbered between 22 and 55 pairs; in 1984 only 3 pairs nested, and there has been no nesting since.

During the winter of 1983-84 tide water broke through a section of the north dike and inundated the saltflat where the terns had nested. Temporary patching held until the 1988-89 winter storms; now there are two areas on this dike that are open to tidal action. Pickleweed now occers the former nesting site. The monitors strongly recommend eradication of much of the pickleweed, and restoration of the site where the terns nested in the early 1980's to its condition at that time.

GUADALUPE DUNES (S. Johnston, J. Dougherty))
Breeding pairs: 15-20

This site was monitored properly and regularly for the first time, with 22 visits between 6 May and 15 July. There were no major problems and productivity was estimated at 0.66-0.75.

The beach and surrounding dunes are now protected against ATV use by a county guard station (Santa Barbara). Coyotes are present and people occasionally walk through the site, but the nests are spread far apart and apparently are not disturbed.

SAN ANTONIO CREEK (K. Palermo, D. Brewer)
Breeding pairs: 3

The 3 nesting pairs did not produce any fledglings. Ten visits were made between 3 May and 25 July, but little information was available on the state of the colony.

PURISMA POINT (K. Palermo, D. Brewer)
Breeding pairs: 16-18

There were 14 nests in the 1st wave, 8 in the 2nd; 4-6 pairs in the 2nd wave were probably renesting. Only two fledglings were believed produced at this site, but the location of the roosting flock has never been determined, so adequate fledgling counts have been done.

Monitors made 29 visits between 15 Apr and 18 Aug.

The site was protected by an electric fence on the north and south sides that connected with a security fence running the length of the east side, where bluffs above the ocean formed a natural fence. The fence charger broke down in July and there was a 10-day interval before it was fixed. This, plus holes in the security fence, may have allowed predators into the colony.

The main predator on both eggs and chicks was presumed to be the coyote. Coyotes were regularly sighted in the vicinity of the colony, and coyote tracks were numerous around nests. Foxes are a possible predator also. A fully functional fence, plus more monitoring to determine what the problems actually are, would be helpful.

SANTA YNEZ ESTUARY (K. Palermo, D. Brewer))
Breeding pairs: 3

Nine visits were made between 2 May and 17 July.

No fledglings appear to have been produced. Temporary fencing and signs were put around part of the area to keep people out, but were not very effective.

SANTA CLARA RIVER (D. Davis, S. Kimple, S. Teresa, and 43 volunteers from Ventura Audubon)
Breeding pairs: 6

Although the colony was small, it was very successful, with 9 fledglings produced by 6 pairs. There was no 2nd wave, an indicator of the success of the 1st; no predation was ever observed.

Prior to the season, giant reed in the vicinity of the site was removed by personnel from the Ventura Port District winter dredge operation. A fence was erected within the state park boundaries. A volunteer-monitor program by Ventura Audubon enlisted the aid of 43 people to police the beach during periods of heavy public use. They logged 43 visits and 165 hr of monitoring time between 15 Apr and 12 Aug.

ORMOND BEACH (S. Teresa, K. Pestana, J. Hanlon)
Breeding pairs: 3

Three pairs of terns nested, and on 5 June two chicks and a fledgling were seen. ORV use of the beach continued to be the major problem, as in all past seasons. The City of Ormond Beach put up barriers to obstruct vehicles, but they were repeatedly damaged or broken. This site needs permanent protection and more regular monitoring. The number of nesting pairs would probably increase if disturbance could be controlled.

POINT MUGU (G. Smith, M. Klope))
Breeding pairs: 86

The site was extroardinarily successful; 115-120 fledglings were documented, for a ratio of 1.33, the highest recorded in California in 1989.

Ninety-one nests were documented; 72 in the 1st wave, 19 in the 2nd. Only 5 pairs in the 2nd wave were believed to be renesting. Thirty-eight visits were made between 12 May and 1 Sept.

Predation was not a problem.

In 1988 many nests were lost in late June when spring tides overwashed the beach. The terns renested, and again were threatened by high tides. A group of volunteers raised 31 nests onto sand-covered platforms and no further damage was done by tidewater. This year overwash occurred 4 times during the breeding season. Again nests were raised (total 50), but 3 were lost despite this effort.

VENICE (K. Pestana, B. Massey, W.A, Schew, K. Corey)
Breeding pairs: 137

The colony was again successful, although it did not do quite as well as in past years. At least 134 fledglings were produced, for a ratio of 0.98. Since the catastrophic El Niño year of 1982, the success rate at this colony has been 1.0 or higher with only one exception (1987).

There were 146 nests, 125 in the 1st wave and 21 in the 2nd. Twelve of the 2nd wave pairs were nesting for the 1st time. None of the chicks from the 2nd wave survived to fledging.

The colony was visited 67 times between 20 Apr and 8 Aug. The fence, new in 1988, worked well again this year; there were no signs of entry by humans, dogs or cats.

The number of pairs was down from 1988, when there were 165. There were 6 abandoned nests early in the season and evidence that a nocturnal predator (owl) was visiting the colony and taking adults. Several color-banded adults from these nests were found renesting later with new mates. Remains of 4 adults were found in the colony in May and June.

There were also signs of a faulty food supply. During the week of 15-22 May, nests were left unattended for hours at a time during the day when usually they are incubated continuously. Only one new nest was laid during that week. In early June, several chicks that were banded and weighed when newly hatched showed no weight gain in a week's time - a rare occurrence. There was no known predation by kestrels, although a male and a female were each seen twice at the colony in June. Mobbing by the terns was frenzied, and although this tactic has not usually been effective, it appeared to startle these predators and send them off.

Crows were around the sanctuary all season, foraging on the beach for trash and often congregating in groups of 5-7 on the adjacent rooftops. A crow or two was often seen on the fence or just inside, foraging along the periphery but not near nests. Mobbing by the terns was ineffectual. On 4 June a crow was observed taking a chick and flying to a rooftop to eat it. Crows were around increasingly in July and again seen taking a chick on 9 July. Crows have been a problem late in the season at Venice for several years, and this season were the main predator on chicks, and probably responsible for loss of all chicks in the 2nd wave. Crows are smart and long-lived, and the group at Venice has definitely keyed in on the colony. Their potential as predators on both eggs and chicks is enormous. A crow control program should be started just before the 1990 season to eliminate this particular group. If there are signs of owl predation, an effort should be made to trap the bird and hold it for the duration of the 1990 tern season.

There were 4 2-egg clutches in which neither egg was viable. After the pairs had incubated for 32-39 days, the eggs were taken and sent to USFWS Laguna Niguel for analysis. Three of the 4 pairs renested at Venice, the 4th was not seen again. A chick hatched at one of the renests, signifying viability on the 2nd attempt; the others were abandoned.

In 1988 there were also two nests where both eggs were non-viable. One of these pairs hatched two chicks at Venice in 1989.

TERMINAL ISLAND (W.A. Schew, K. Keane, K. Pestana)
Breeding pairs: 19

By agreement with the agencies, the Port of Los Angeles is planning to phase out the Ferry St. site that has been used by the terns since 1985 and relocate the nesting site to an area approximately 1/4 mi north of the present one. The new site is called SA as it is close to the seaplane anchorage. The SA site consists of 8 acres of clean white sand that was transported there, fenced on 3 sides (all except the east side which abuts the water), and partially fenced with small-mesh chicken wire as well. This season the terns had these two choices for nesting, and used both.

During the period 11 Apr - 17 Aug, 51 visits were made by monitors.

In early May, 15 pairs nested on the traditional site but crows destroyed all nests on 22 May. On 7 June terns began to nest at the SA site and by 17 July there were 6 nests. There was no predation and 6 fledglings were produced at this site, a ratio of 1.0.

Pre-season, a major effort was made by ADC (funded by USFWS) to eliminate the band of crows that has frequented the area for several years and caused destruction and abandonment of the colony before. Chicken eggs were set out to condition the crows to feed at specific sites. Once the crows were habituated, eggs were laced with DRC-1339. The poison appeared to work and the crow population was reduced; but after 11 days, 8 crows were again seen near the site, just prior to the predation incident of 22 May. Crows apparently never keyed in on the new site; the assumption is that it was not on their regular foraging route. Crow removal should be done again just prior to the 1990 season.

No other predators were identified, although several were seen in the vicinity, e.g. American Kestrels, Great Blue Herons. There were no feral cats, often a serious predator in the past.

ANAHEIM BAY (M. Silbernagle, S. Montoya, S. Clay, T. Charmley) Breeding pairs: 97

Ninety-seven nests were laid, and 97-120 fledglings were produced for an extremely successful season (ratio 1.0-1.24). Thirty-six visits were made between 11 Apr and 12 July.

There was no mammalian predation, the electric fence was effective throughout the season. A kestrel was the documented predator on 5 chicks, and one was taken by a shrike. Attempts to trap the kestrel were unsuccessful.

Essentially, this colony was problem-free in 1989.

BOLSA CHICA (W.A. Schew, E. Burkett, M. Bounds) Breeding pairs: 115

Of the 106 pairs that nested in the 1st wave, 11 were on the North Island, 95 on the South Island. All 20 2nd wave nests were on the South Island. The site was visited 15 times between 21 Apr and 1 Aug. Although the number of breeding pairs was higher than last year's 89-94, only 45 fledglings resulted, for a very poor ratio of 0.39.

North Island. Eleven pairs nested starting in late Apr; there may have been several fledglings, but none was ever documented. The arrival of large numbers of Elegant and Caspian Terns and Black Skimmers was believed to inhibit any further Least Tern nesting, and renesting was all on the South Island.

South Island. Nesting began at the same time as on North Island, with a total of 122 for the season. No egg predation was recorded but a heavy toll was taken on chicks by kestrels. Four kestrels were trapped and relocated, and one was shot. (The latter had been trapped in 1988 and relocated to Banning, and was back taking chicks again in 1989.) Their places were quickly taken by new ones. A limit on the number of traps and trappers, coupled with simultaneous kestrel problems at Huntington Beach and Anaheim Bay resulted in a less-than-adequate defense against this most effective avian predator.

Recommendations for 1990 include preparations for kestrel trapping that will be adequate to meet the problem, shelters (roofing tiles) to provide more cover for chicks, leaving clumps of vegetation on the island for chick cover, and discouraging other species of terns and skimmers from nesting on South Island if they should try.

HUNTINGTON BEACH STATE PARK (W.A. Schew)
Breeding pairs: 70

The colony experienced a disastrous season, with 22 nests abandoned and only 5 fledglings produced. There was no 2nd wave, no tern activity at all after 10 July.

Severe predation by kestrels was the cause of both abandonment and loss of chicks. Efforts to trap kestrels were ineffectual because of the human activity around the sanctuary, and because traps and trappers were engaged elsewhere (see Bolsa Chica). Crows were seen all season but were implicated in the destruction of only one nest. After the terns abandoned, crows ate the eggs.

The fence was rehabilitated in 1989 and proved totally effective in keeping out mammalian predators. The site was monitored with 15 visits between 19 Apr and 1 Aug.

Recommendations include adding more tiles for chick cover, and a program in readiness for kestrel removal as necessary. At this colony and Bolsa Chica, kestrels have been a major cause of chick loss for many seasons. Because the kestrel problem is so severe at HB and BC, its solution should be a priority item in 1990.

UPPER NEWPORT BAY (W.A. Schew, M. Bounds)
Breeding pairs: 74

The colony was moderately successful with 81 nests (all but one in the 1st wave) and 55 fledglings. The ratio was 0.74. The site was monitored 25 times between 19 Apr and 27 July, but only twice by on-site visits.

Lack of a 2nd wave was considered due more to a shortage of food that discouraged renesting, than to outstanding success of the 1st wave (which would have meant more

fledglings). On-site monitoring was restricted by DFG, therefore monitoring was mostly done from the mainland. The number of breeding pairs can be estimated with some accuracy from off-site, but clutch size, fledging success and predation were considered less certain than for other colonies where close observation was used.

SANTA MARGARITA RIVER (L. Belluomini, J. Tutton, D. Statlander, K. Keane) Breeding pairs: 173

The terns nested at two locales on Camp Pendleton: the mouths of Aliso Creek and the Santa Margartia River. The site used by Least Terns at Aliso Creek is designated "White Beach". At the Santa Margarita River mouth, the terns nested on both sides of the river; the site in the north side is designated "North Beach". Tern nesting areas on the south side of the river include "Salt Flats" and Salt Flat Island". White Beach has not been used since 1986; the other 3 were nesting areas last year. Fledgling production was poor except at White Beach. The ratio for the 4 sites combined was 0.46.

A total of 267 nests were documented: 195 at North Beach, 16 at Salt Flats, 27 at Salt Flats Island, and 29 at White Beach. Many were renests, and the number of pairs was only 173, a considerable decrease from 246 pairs in 1988. The first egg was laid on schedule on 7 May, but thereafter the chronology of new nests was quite different from the norm. On 17 May there were 11 nests; on the same date in 1988 there were over 100. There were many indications during the season that there was a problem with the food supply. About 30 color-banded birds that regularly nest at SMR were found breeding at other colonies.

Predators took a large toll on both eggs and chicks, despite a major effort to eliminate potential predators from the region by ADC. The California Ground Squirrel was considered the major predator on eggs, destroying 44 nests in late May. Northern Harriers wer considered to be major chick predators in late June, with predation occurring primarily between 21 and 23 June. Five harriers were subsequently shot by ADC. Additional documented egg predators were Western Meadowlark and Common Raven.

There was a 2nd wave of 25 nests at North Beach but only one late nest at White Beach and none at the other sites. Very few 2-yr old terns were documented in the 2nd wave. The poor fledgling crop of 1987 plus a problematical food supply this year are the presumed reasons for the small number of 2-yr olds.

North Beach A mile of beach was enclosed in an electric fence. Chick fencing was also put around the perimeter. Extensive trapping of potential mammalian predators was done by ADC before the terns arrived and all during the season. Aerial predators like crows, ravens, kestrels and Northern

Harriers were also trapped or shot. Despite these measures, a predator (the evidence points to ground squirrels) destroyed 44 nests with eggs. Because of this early-season predation there was a lot of renesting during the 1st wave. Some of the terns renested at North Beach, others at White Beach, and some were not seen again.

Predation on chicks was severe in June, but the major predators were not identified. In late July several Northern Harriers began to focus on the colony; they destroyed two egg nests, and were probably the major predator on chicks. The 2nd wave of nesting took place in late June and early July; of 25 pairs, only 6-8 were 2-yr olds, the rest were renesters. Many of these nests were outside the fence on the south side, protected only by post-and-wire fencing and signs.

Only 50 juveniles fledged from 125 pairs nesting at this site.

White Beach The site was posted and protected by a post-and-wire fence, which deterred humans but was no protection against ground predators. ADC did control trapping before and during the breeding season, but did not take ravens because of the research study on this species that was being done there. Despite lack of protective fencing, the colony fared very well and produced 12 fledglings, a ratio of one/pair.

The 1st nest was found on 21 May, and over the next few weeks 12 pairs nested. One late nest was found in July.

Saltflat Twelve pairs nested inside an electric fence and produced 6 fledglings.

Saltflat Island The 26 pairs that nested produced 11 fledglings.

All sites were visited on alternate days during the period of active breeding; North Beach was visited 52 times, White Beach 42 times, the others 39 times. In addition, researchers were in blinds in the colony 3-4 days/week and helped monitor the progress of the colony.

BUENA VISTA LAGOON (J. Konecny, T. Stewart, L Patla)
Breeding pairs: 16

Least Terns nested here for the 1st time this year. Additional sand was put on the islands before the season to improve the substrate, and decoys were used to attract terns.

There were 22 nests by an estimated 16 pairs, all on the northeasternmost island. The 6 nests in the 2nd wave were all considered renests. Six fledglings were produced.

A raccoon was trapped on the island in June, but there were fresh raccoon tracks subsequently.

Twenty-six visits were made between 23 Apr and 17 Aug. The first 8 (through 13 June) were confined to observations from the shore, thereafter a boat was available for site visits.

Access by boat should be made available throughout athe season next year. Chick shelters are needed. ADC should be consulted to evaluate predator control options. Because it is an ecological reserve, only confirmed predators on Least Terns should be removed.

BATIQUITOS LAGOON (J. Konecny)
Breeding pairs: 3

The lagoon was closed all spring, and there were very few dry areas suitable for nesting. Three pairs nested in the northeast corner, but ORVs and predators caused the loss of all 3 nests.

ORVs were a major problem, and the nesting site in the NE corner should be fenced, either temporarily during the tern season, or with permanent fencing.

SAN ELIJO LAGOON (R. Patton, S. Welker, L. Patla)
Breeding pairs: 17

The islands were cleared of vegetatin in the spring and decoys placed on them. Only one pair of terns attempted to nest on an island. The overwhelming presence of predators around these islands is presumably a big deterrent.

Sixteen pairs nested on the mudflat adjacent to the flood control dike. This site is subject to human disturbance as well as a legion of predators. A wire fence and signs were placed as a deterrent and were effective. There were 30 nests, but late nests were considered renests. Only 3 nests survived to hatching, and 4 fledglings resulted from these 3 nests. Two pairs incubated infertile eggs for 30 and 37 days.

Many color-banded adults that had nested at SMR in 1988 were present and nesting in early July.

The site was observed from the dike 39 times, and there were 4 site visits between 12 Apr and 31 Aug.

FAA ISLAND (J. Price, L. Patla)
Breeding pairs: 125

Vegetation was cleared by hand by volunteers, and the chick fence rebuilt to make it safer.

This was the 3rd largest colony in the state, and produced 90+ fledglings, for a ratio of 0.72. A number of color-banded adults that had nested at SMR in 1988 nested here in 1989.

Several nests were predated in the egg stage by Western Meadowlarks. There was no more predation after two were shot. Two Rock Doves and one Western Gull were also shot. Ten shrikes were trapped on Fiesta Island, from where they had been coming to take chicks in previous years. Predation on

chicks was heavy, but undocumented. Headless remains strongly implicated a raptor.

There were 120 nests in the 1st wave prior to mid-June. The 2nd wave was large, but of the 34 nests only 5 were considered first time nesters.

The island was visited 62 times between 10 May and 31 Aug.

MARINER'S POINT (J. Tutton, L. Patla)
Breeding pairs: 2

This is one of 6 sites the City of San Diego designated as a 'short term' site. It is approximately 3 acres in size and has been fenced for 4 years, but not used by the terns until this season. This was the first year decoys were placed on the site. It is now considered a permanent nesting site by the city.

The first nest was found 4 June. Although the site was fenced, one of the two nests was run over by an ORV. Two later nests were believed to be renests. One fledgling was produced here.

There were 28 visits between 17 Apr and 10 Aug.

NAVAL TRAINING CENTER (G. Johnson, M. Evans-Layng, E. Copper)
Breeding pairs: 0

Terns were seen sporadically early in the season but no nesting attempts were made. The presence of predators probably deterred them. Ravens were on the site and observed eating Killdeer eggs, and owls were very probably present. Three shrikes were trapped and removed.

LINDBERGH FIELD (J. Price, R. Patton, M. Evans-Layng, T. Stewart) Breeding pairs: 9

Chick barriers were erected around 3 ovals to prevent chicks from moving onto the runways. ADC was contracted to do predator control. Contractors were hired by the Port to monitor the terns at night. All these steps were taken to satisfy USFWS condiations to protect terns while the runway was being repaired.

There was no successful nesting, and the site was abandoned 20 June by the terns. Nocturnal predation by an owl was the presumed cause of failure.

The site was visited 15 times between 23 Apr and 10 Aug.

NORTH ISLAND, NAVAL AIR STATION (M. Evans-Layng, L. Belluomini, E. Copper, R. Patton)
Breeding pairs: 24

ADC maintained an extensive trapping program and removed a large number and diversity of predators. The nesting season was more successful than any since 1985, and the success is credited to the trapping program. Only 2 or 3 egg nests were preyed upon, but 14 were abandoned, with disturbance (gulls, cats, and others) thought to be the cause of nest desertion. Ravens, American Kestrels, Burrowing Owls, and possibly Peregrine Falcons preyed on chicks.

There were 32 nests, but the 8 pairs in the 2nd wave were considered renesters. Productivity was fair, with 13-14 fledglings produced by 24 pairs (0.58).

The site was monitored on 82 visits between 17 Apr and 21 Aug.

DELTA BEACH (L. Belluomini, M. Evans-Layng, R. Patton)
Breeding pairs: 33

The colony was very successful, fledging 40+ young for a ratio of 1.2. There were 20 nests in the 1st wave, 26 in the 2nd, of which half were judged new pairs.

One nest in danger of being flooded was elevated, and although one of the adults returned the other did not and the nest was abandoned. Two nests were trampled by jackrabbits. One chick was stepped on by an unauthorized person on the site. ADC was under contract to trap and remove predators throughout the season. Kestrels, shrikes and ravens were taken. A juvenile Peregrine Falcon was around for a week and was seen eating an adult Least Tern.

Eighty-eight visits were made by monitors between 17 Apr and 15 Aug.

D STREET FILL (D. Stadtlander, J. Tutton, L. Patla, M. McGill) Breeding pairs: 2

The site is now in a federal refuge and under the jurisdiction of USFWS. Last year the 19 nest colony was destroyed before hatching by skunk(s); this year FWS staff had a trapping program to eliminate skunks. Nevertheless as skunk was the probable predator on one of the two nests. A gopher snake was observed eating the other. One shrike was trapped and removed.

The site needs vegetation removal, fencing and predator control to give the terns a chance to nest successfully.

Seventeen visits were made by monitors between 17 Apr and 10 Aug.

CHULA VISTA WILDLIFE RESERVE (D. Stadtlander, J. Tutton, L. Patla) Breeding pairs: 28

Only 10 fledglings were produced by 21 pairs, a poor ratio of 0.48. There were 21 nests in each wave, but many 2nd wave nesters were presumed to be renesting.

The Port District cleared the western part of the reserve for the terns' use, and destroyed ground squirrel burrows during the winter to preclude their occupation by Burrowing Owls.

The 1st 14 nests were all predated by a striped skunk. Two skunks were caught subsequently in traps, plus a feral cat. Caspian Terns were observed taking eggs, a new predator added to a long list. They were not seen taking chicks, but may have done so, as they were observed eating chicks at the Saltworks.

Monitors visited the site 37 times between 17 Apr and 10 Aug.

SALTWORKS (J. Price, T. Stewart, E. Copper)
Breeding pairs: 28

The colony suffered disastrously from predation by Caspian Terns, the 1st recorded predation by this species. At least 3 Caspian Terns were involved, and it was assumed that once they keyed in on this food source, they took all the eggs and chicks they could find. One nest was destroyed by a vehicle on the levee. Only 3-5 fledglings were produced, a ratio of 0.2.

In an effort to lure Caspians close enough to be shot, pheasant chicks were put out. The Caspians hovered over the chicks but did not take them, and were not shot.

The site was visited 36 times between 21 Apr and 23 Aug.

TIJUANA RIVER ESTUARY, BORDER FIELD STATE PARK (R. Patton, D. Patton, L. Patla, M. McGill)
Breeding pairs: 49

Least Terns nested at two sites south of the river mouth and two on the north side. In 1988 three of the sites were used, this year the terns also nested 1 km south of the river mouth (about 1 km north of the international border). Up to 70% of nest destruction was due to human activities. The nesting sites are on the main route of people entering the US illegally from Tijuana, and fencing and signs have done little good. Nests were stepped on at night, and most damage was on the south side of the river mouth. On the north side, fishermen, dog-walkers, beach-goers and unleashed dogs and cats were more of a problem than illegal aliens. Most nests were destroyed in the egg stage. Although there were many potential predators in the area, there was no evidence that they were preying on chicks. The site where the terns had

most success was on the south side of the river mouth, outside of the secured area, and somewhat inland of the main route that undocumented aliens take along the beach.

There were 30 nests in the 1st wave, 44 in the 2nd, with half presumed renesting. Despite nest destruction, many chicks did hatch and 23-31 juveniles fledged from the colony, a ratio of 0.55.

There were 22+ visits between 20 Apr and 29 Aug.

The problems at this location are different from any others and need to be addressed through inter-agency coordination (Border Patrol, USFWS, State Parks) to do long-range planning to protect this vital site.

BANDING & RESEARCH

Chicks were banded at ?? colonies:

COLONY	# CHICKS
Terminal Island	4
Venice	148
Bolsa Chica	135
Huntington Beach	37
Upper Newport Bay	41
Camp Pendleton	219
North Beach - 142	
Saltflat - 16	
Saltflat Isl - 27	
White Beach - 25	
Buena Vista Lagoon	4
FAA Island	212
Mariner's Point	1
Lindbergh Field	5
North Island	28
Chula Vista Reserve	5
Delta Beach	55
Saltworks	7
Total	901

Adults were trapped and color-banded at 2 colonies:

Venice	30
Camp Pendleton	46
Total	76

Research on banded adults at Venice was continued by Barbara Massey. For the 7th year in a row, an effort was made to identify all banded adults and note age, sex, mate, site of nest in colony, clutch size, hatching success, and renest if it occurred. This was the final year of the study. The

data will be analyzed to determine the age profile of the colony, with all of the effects of the 1982-83 El Niño taken into account.

Research on banded adults at Camp Pendleton continued with Patricia Baird, Barbara Massey, Charles Collins and William Schew participating. The objective there is to band every adult possible in order to determine annual survival rate, mate selection and retention, intra-colony movements of pairs, and other parameters.

DISCUSSION AND CONCLUSIONS

In 1989 there were 28 active California Least Tern breeding sites in the state (Table 1), the same number as in 1988. Two sites used in 1988 were not used this year (Port Chicago in San Francisco; Naval Training Center in San Diego) but they have not been major sites; one pair nested at each in 1988. Several sites not in use in 1988 were occupied this year: one was entirely new (Mariner's Point, San Diego), the others were used again after a lapse of several years (Santa Inez River mouth, Santa Barbara; White Beach on Camp Pendleton). Only White beach had a sizeable number of pairs (12).

The number of breeding pairs decreased from 1253 in 1988 to 1240 in 1989 (Table 1). On the adult population graph the decrease is scarcely noticeable (Fig. 1) and is not significant. The adult population is expected to rise again in 1990 when the bumper crop of fledglings from 1988 begins to nest as 2-yr olds. However, with this year's poor fledgling production we can expect another plateau in 2-3 years. We are beginning to be able to predict population trends as fledgling counts become more accurate.

Fig. 2 is a map of California's breeding colonies showing the 5 clusters into which the colonies group. Table 2 gives a population breakdown by cluster in 1988 and 1989. The northernmost cluster was up about 15%; the San Luis Obispo/Santa Barbara cluster was up 100% and back to the 1987 level; Ventura was down a few pairs; LA/Orange about the same; and San Diego down 10%.

The first eggs were found on 2 May at Venice and Anaheim Bay; the first fledgling was seen at Venice Beach on 14 June. Dates for first nests were generally on the schedule of previous years, but at study colonies like Venice And Santa Margarita River, the timetable was very different from normal as the season progressed. At both sites, 3-yr olds and 2-yr olds nested later than is customary. The mean clutch size for 17 sites up and down the state was down to 1.84 ± 0.48 as compared to 1.92 ± 0.49 in 1988 (Table 3). Both lateness of nesting and reduced clutch size were apparently linked to poor food supply.

Table 4 summarizes the activity period at each colony, which was not different from 1988.

There was a 35% decrease in the number of fledglings compared to 1988 (Table 1). The fledgling/pair ratio also decreased; in 1988 it was 0.9, this year it was 0.62. Looking at the figures in terms of clusters (Table 2) the number of fledglings was the same or greater in the 3 northern clusters, but down sharply in the two southern California clusters. In San Diego particularly, this year's fledgling crop was down 70%.

Predation was again the major problem for most colonies. Predators that took the heaviest tolls were American Kestrels (at Anaheim Bay, Bolsa Chica and Huntington Beach), American Crows (at Terminal Island and Venice), Northern Harriers (at Oakland Airport and Santa Margarita River), and ground squirrels (at Santa Margarita River). The red fox, a serious predator in 1988, was kept under control this year by trapping around several sites that have been marauded in the past. Additionally, a rehabilitated fence at Huntington Beach helped prevent incursions there. Caspian Terns were a newly documented predator this year and caused severe losses at Chula Vista and the Saltworks. Poor fishing may have been responsible for this unusual occurrence, the larger terns may have been searching for supplementary food in a bad year. In other places predators were not so readily identified, nor were the losses as severe.

The problem of predators and how to handle them has increasingly dominated Least Tern management programs. The services of ADC have been engaged by the Navy for its colonies at Alameda, Camp Pendleton, and several installations in San Diego Bay, by USFWS for the Seal Beach Wildlife Refuge in Anaheim Bay and by California Department of Fish and Game at Bolsa Chica. Strategies have ranged from selective removal of problem animals to trapping before the tern season of all possible predators. In some places this procedure has resulted in many more animals being caught and killed than are actually predators on tern eggs and chicks; and in some cases the ecological balance, which is already disrupted throughout coastal California, may be further upset by overtrapping. Yet the older method of responding to predation when it occurred often meant the response was too little and too late. Most monitors have included queries in their reports about how to approach predator control. A report is being prepared by Leora Feeney summarizing the history of predation on Least Terns, measures that have been taken, and the effectiveness of control measures. It will be used as the basis for a document of guidelines for monitors.

Five colonies had good to very-good seasons - Alameda, Guadalupe Dunes, Point Mugu, Venice, and Anaheim Bay. Several that did well in 1988 fared poorly this year - Santa Margarita River, FAA Island and Chula Vista. Once again the Venice and the Santa Margarita River colonies received the most attention in terms of monitoring and research activities of any in the state, with people present virtually every day

May-July. Predator control at the Santa Margarita River sites was again pursued intensively before and throughout the season. In 1988 the program was effective, but this year there were heavy losses from predation despite the trapping program. The colony fledged only 81 juveniles, a ratio of 0.47.

Monitoring was considered very good at almost all colonies. There was only one CDFG seasonal aide, compared with 3 in 1988, but two others were hired under this contract. It continues to be very important to manage and protect even the very small colonies, and to preserve sites that have been temporarily abandoned, usually because of heavy predator pressures. This year Santa Inez River mouth and White Beach were used for the first time in several years. Only 3 pairs nested at Santa Inez, but the 12 pair colony at White Beach showed higher fledgling productivity than any of the other Santa Margarita colonies and was relatively predator free.

A pair of Least Terns apparently nested successfully at Capistrano Beach; in early July adults were seen feeding a large chick that was close to fledging (Brian Daniels, pers. comm.). Another interesting observation was made on the beach at Pismo Dune State Vehicular Recreation Area. On 24 July Chris Otahal watched a group of 30 Least Terns for about 2 1/2 hr while doing a shorebird census. There were two juveniles in the group, but they were not seen being fed; many of the adults were engaged in courtship behavior and copulation.

In Baja California, Eduardo Palacios of CICESE in Ensenada is working for an MA and doing his thesis on Least Terns under the guidance of Dr. Charles Collins of CSULB, among others. He gathered data on 4 colonies - Estero de Punta Banda in Ensenada and San Quintin on the west coast, Laguna Percebú Norte and Laguna Percebú Sur on the gulf side. A total of 216 pairs nested at these sites, producing 289 chicks, but only 86 fledglings. Most failures could be attributed to human disturbance.

RECOMMENDATIONS

Predation and its control have become increasingly important in Least Tern management. There is concern and controversy over how it is to be done, and what measures are really effective. Before the 1990 season there should be a summary of the history of predators and predator control at tern colonies, followed by a committee meeting to set guidelines and write a document for monitors. This should be a top priority for the 'working group'.

Monitoring should be continued at all colonies at least at the level of 1989. More help should be given to personnel at Point Mugu and Vandenberg Air Base to assist in monitoring those difficult and important sites. Ormond Beach and the VAB

colonies need better protection from disturbance and predators.

At colonies where there are known predators every year (e.g. crows at Terminal Island and Venice, harriers at Oakland), pre-season measures should be taken. In San Diego, a full-time ADC staff person is wanted to do pre-season control on feral animals, and to concentrate on selected sites during the breeding season. It is hoped that there will be good guidelines on what is most effective by next season.

Fledgling counts should be done as recommended by Massey - see separate report. Counts of the roosting flock at dusk at least twice during the post-fledging period would give the most reliable results, and standardize the procedure.

If the population is to continue to rise, new sites must be created and current sites expanded to accommodate increasing numbers of breeding pairs. Beach sanctuaries are the optimum sites, as there are usually fewer predators to deal with. Alternate sites are in particularly short supply in Los Angeles and Orange Counties, where the population is increasing most rapidly (both terns and humans).

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Dave Bradley, a computer scientist at CSULB, has done the calculations on clutch size for the past two years, to determine mean and standard deviation for the whole population, for which I am most grateful.

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Laura Collins*, Leora Feeney, Scott Johnston*, Barbara Massey, Charles Collins, Kathy Keane, Elizabeth Copper*, San Francisco Bay Bird Observatory *, William Schew*, Grace Smith, Ken Corey*, Esther Burkett, Jane Tutton*, Doreen Stadtlander*, Robert Patton*, Debra Patton *, Mike McGill, Jennifer Price*, John Konecny*, Marit Evans-Layng*, Ventura Audubon Society*, Karen Pestana*, Marilyn Bounds*, Laurie Patla, Mike Silbernagle, Linda Belluomini, Sherry Teresa, John Hanlon.

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Table 1. California Least Tern breeding colony size and fledging success, 1988 and 1989.

Colony	Estimated # of pairs (fledglings)			
	1988		1989	
P.G.E., Pittsburgh	3	(1)	3-4	(2)
Port Chicago	1	(0)	0	(0)
NAS Alameda	58-67	(80-87)	72-75	(83-93)
Oakland Airport	6-7	(0)	6-7	(2)
Guadalupe Dunes	10-12	?	15-20	(10-15)
San Antonio Creek	7	(3)	3	(0)
Purisma Point	3	(1)	16-18	(2)
Santa Inez River	0	(0)	3	(0)
Santa Clara River	2-3	(4)	6	(8)
Ormond Beach	2-4	?	3	(1)
Point Mugu	100	(25)	86	(115-120)
Venice Beach	165	(192)	137	(134)
Terminal Island	4-6	(0)	19	(6)
Anaheim Bay	75-90	(60-71)	97	(97-120)
Bolsa Chica TOTAL	89-94	(62-67)	115	(45)
North I.	[9	(7)	11	(0)]
South I.	[80-85	(55-60)	95	(45)]
Huntington Beach St Pk	86	(43)	70	(5)
Upper Newport Bay	70-75	(50-60)	74	(55)
Sta Margarita River TOTAL	246	(365-409)	173	(81)
White Beach	[0	(0)	12	(14)]
North Beach	[184	(269-276)	125	(50)]
Saltflat	[27	(38-40)	12	(6)]
Saltflat Isl	[35	(58-65)	26	(11)]
Buena Vista Lagoon	0	(0)	16	(6)
Batiquitos Lagoon	48	(25-30)	3	(0)
San Elijo Lagoon	11	(3)	17	(0)
FAA Island	37	(50)	125	(30)
Naval Training Center	1	(1)	0	(0)
Mariner's Point	0	(0)	2	(0)
Lindbergh Field	80	(30)	9	(0)
Chula Vista Wildlife Res	24	(30-40)	28	(5-8)
D Street fill	19	(0)	2	(?)
North Island NAS	20	(4)	24	(13-14)
Saltworks	17	(15)	28	(2-4)
Delta Beach	7	(10)	33	(20)
Tijuana River Mouth	40-47	(24-36)	49	(17-23)
TOTALS	1228-1278	(1078-1182)	1234-1245	(739-789)
POPULATION ESTIMATES	**1253**	**(1130)**	**1240**	**(764)**

Table 2. California Least Tern breeding colony size and fledging success by cluster, 1988 and 1989.

Colony	Estimated # of pairs (fledglings)			
	1988		1989	
SAN FRANCISCO, ALAMEDA P.G.E., Pittsburgh, Port Chicago NAS Alameda, Oakland Airport	68-78	(81-88)	81-86	(87-99)
SAN LUIS OBISPO, SANTA BARBARA Guadalupe Dunes, San Antonio Creek,Purisma Point, Santa Inez River	20-22	(4)	41-46	(12-17)
VENTURA Santa Clara River, Ormond Beach, Point Mugu	104-107	(29)	95	(124-129)
LOS ANGELES, ORANGE Venice Beach, Terminal Island, Anaheim Bay, Huntington Beach SP, Bolsa Chica, Upper Newport Bay	489-516	(407-433)	510	(342-355)
SAN DIEGO Santa Margarita River, Buena Vista Lagoon, Batiquitos Lagoon, San Elijo Lagoon, FAA Island, Naval Training Center, Mariner's Pt, Lindbergh Field, Chula Vista Wildlife Reserve D Street fill, North Island NAS Saltworks, Delta Beach, Tijuana River Mouth	550-557	(557-588)	509	(174-192)

Table 3. Clutch size of California Least Terns in 1989 [1].

Colony	# nests	clutch size 1egg	2eggs	3eggs	X ± SD
NAS Alameda	78	6	61	11	2.06±0.47
Guadalupe Dunes	11	2	9	0	1.82±0.40
Purisma Point	15	3	12	0	1.80±0.41
Point Mugu	87	10	70	7	1.97±0.44
Venice Beach	150	19	119	12	1.95±0.45
Terminal Island	21	1	20	0	1.95±0.22
Anaheim Bay	96	11	78	7	1.96±0.43
Bolsa Chica	133	34	92	7	1.80±0.52
Huntington Beach SP	71	7	63	1	1.91±0.33
Sta Margarita River	267	64	197	6	1.78±0.46
Buena vista Lagoon	22	4	18	0	1.82±0.39
FAA Island	154	29	116	9	1.87±0.48
Chula Vista Reserve	42	19	23	0	1.55±0.50
North Island NAS	32	6	23	3	1.78±0.61
Delta Beach	46	18	28	0	1.60±0.49
Saltworks	39	15	24	0	1.62±0.49
Tijuana River Mouth	66	24	41	1	1.65±0.51
				Total Mean	**1.84 ± 0.48**

[1] Not available from every colony. Data used only when colony contained 10 or more nests.

Table 4. Period of breeding activity, date of first egg, chick and fledgling.

Colony	Activity Period	Date of 1st Egg	Chick	Fledgling
PGE, Pittsburgh	5/02 - 7/14	5/16	6/06	6/20
NAS Alameda	4/26 - 7/13	5/10	6/01	6/20
Oakland Airport	5/12 - 7/08	5/20	5/11	7/03
Guadalupe Dunes	5/06 - 7/15	5/20	6/10	7/07
San Antonio Creek	5/03 - 7/12	6/09	?	?
Purisma Point	4/27 - 8/10	5/23	6/14	7/10
Santa Inez River	5/02 - 7/17	6/11	?	?
Santa Clara River	5/05 - 9/12	5/27	6/17	7/08
Point Mugu	5/12 - 9/12	5/16	6/10	7/02
Venice Beach	4/20 - 7/03	5/02	5/24	6/14
Terminal Island	4/19 - 8/17	5/07	5/23[1]	7/17
Anaheim Bay	4/11 - 7/12	5/02	5/24	6/13
Bolsa Chica	4/21 - 7/24	5/02	5/23	6/16
Huntington Beach SP	4/19 - 7/10	4/25	5/16	6/19
Upper Newport Bay	4/19 - 7/27	5/09	5/26	6/19
Santa Margarita River	?	5/07	5/29	6/30
Buena Vista Lagoon	4/23 - 8/10	6/13[2]	6/20	7/18
Batiquitos Lagoon	4/30 - 8/11	5/22	0[3]	0
San Elijo Lagoon	4/22 - 8/31	5/14	6/14	7/03
FAA Island	5/10 - 8/24	5/11	5/29	6/19
Mariner's Point	4/29 - ?	?	6/13	?
Lindbergh Field	5/03 - 6/13	5/10	6/01	0
Chula Vista W R	5/01 - 8/10	5/21	6/27	7/18
D Street fill	4/17 - 7/10	6/05	0	0
North Island NAS	4/27 - 8/19	5/11	6/02	6/30
Saltworks	4/21 - 8/23	5/25	6/13	6/13
Delta Beach	4/18 - 8/28	5/22	6/13	7/05
Tijuana River Mouth	4/28 - 8/29	5/23	6/13	7/11

[1] All nests at 1st site predated, terns renested at 2nd site - see text.

[2] Date of 1st visit to island where terns were nesting.

[3] 0 = All nests predated before hatching